Review Article

Systematic Review on Technological Devices for Anemia Screening from 2003 to 2024

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Abstract - Anemia, a global concern, is linked to health problems, especially in Mexico and Peru. Early detection and treatment are critical to preventing complications and improving quality of life. Using Scopus, a systematic review focused on key terms such as "anemia" and "device" was conducted. The Scoping Review approach explored trends and gaps in diagnostic methods and devices, identifying 4,329 papers from 2003 to the present. Geographic distribution revealed disparities in the global representation of research. The Mayo Clinic and Harvard Medical School stood out in affiliations, while Mehran, R. and Passias, P.G. were prominent authors. Original research in articles was prominent, with a decline observed in 2023 based on time trends. Key terms such as "anemia," "patients," and "methods" highlighted crucial areas of research. In conclusion, the systematic reading and analysis of the articles highlight the need to improve the filtering stage in the methodology. There is a consensus on the creation of a Point of Care (POC) device to measure anemia, with long-lasting quality and backed by an exemplary gold standard. These findings point to a future direction in research focused on innovations to address anemia globally.

Keywords - Anemia, Scopus, Point of Care (POC), Diagnostic methods, Technological Devices.

1. Introductión

Health problems affect a considerable number of people worldwide. Diseases such as anemia exert a direct influence on the normal functioning of the systems that make up the human body [1], [2]. In countries such as Mexico, cases of anemia associated with low hemoglobin levels have been linked to acute heart failure, exacerbating both short- and long-term mortality rates [3]–[5]. In the Peruvian context, it is observed that people affected by anemia face a considerable risk of mortality, being 11.4 times more likely to die, especially when they also have comorbidities such as heart failure, as indicated in the study on the risk of death from congestive heart failure in anemic patients in the Peruvian population [6], [7]. This finding highlights the importance of addressing anemia and its connections to other medical conditions to improve health outcomes and reduce mortality rates in the Peruvian population. Anemia affects people by reducing the number of red blood cells and, thus, the oxygen-carrying capacity of the blood. The main causes are usually iron deficiency, chronic diseases, blood loss from bleeding, or genetic disorders. This condition can lead to fatigue, weakness, paleness, and difficulty concentrating [8], [9]. In severe cases, anemia can affect cognitive development in children and increase the risk of complications during pregnancy. In addition, a lack of oxygen in tissues can lead to cardiovascular problems and weaken the immune system, compromising the body's ability to fight disease [10]–[12].

Early detection and appropriate treatment are critical to preventing complications and improving the quality of life for those suffering from anemia [13]. On the other hand, iron is considered one of the fundamental micronutrients for human development; it plays a vital role in regulating hemoglobin levels through sequential processes [14]–[17]. In this process, the hormone hepcidin, produced by the liver, plays a crucial role in intervening in iron homeostasis. Alterations in blood iron concentrations can have significant repercussions on hemoglobin production, thus underscoring the importance of maintaining proper balances to ensure optimal biological functions. In this way, hemoglobin is an essential protein; it plays a fundamental role in the oxygenation of the blood and the irrigation of the tissues in the human organism [18]–[21]. According to the World Health Organization (WHO), normal hemoglobin levels range from [minimum value] to [maximum value], marking a crucial standard for maintaining health and proper functioning of the circulatory system [22].

Likewise, anemia manifests itself more frequently in pregnant women since the growth of the fetus requires a significant amount of iron [23]–[27]. This micronutrient is acquired through the process of erythropoiesis, which involves the destruction of red blood cells to meet the demands of fetal development. This situation highlights the critical importance of maintaining adequate iron levels during pregnancy to prevent and treat anemia, thus ensuring optimal health for both mother and baby-to-be [28].

Simultaneously, devices such as digital hemoglobinometers and hematology analyzers play a crucial role in the prevention and early detection of anemia [22]. They facilitate the quick and accurate measurement of hemoglobin levels in the blood, allowing an efficient assessment of the state of anemia [29]. These devices are especially useful in clinical and community settings, where testing can be performed quickly and non-invasively, making it easier to identify the condition early [30], [31]. Early detection is critical to initiating timely interventions and treatments, such as iron supplementation or correction of other nutritional deficiencies, thus contributing to preventing and addressing anaemia effectively [32]–[35].

Meanwhile, the use of devices such as digital hemoglobinometers and hematology analyzers is beneficial in the field of health, especially for the evaluation of anemia. These devices provide fast and accurate measurements of hemoglobin levels, facilitating early detection of anemia. Their usefulness lies in their portability, ease of use, and ability to perform noninvasive testing, making them appropriate for both clinical and community settings [36], [37]. Efficiency in obtaining results contributes to faster and more effective intervention, allowing healthcare professionals to make informed decisions about the treatment and management of anaemia in patients [38].

On the other hand, [39] in his research titled "Comparison of Hemoglobin Assessments Performed by HemoCue and Two Automated Hematology Analyzers in Young Children in Laos" focuses on assessing hemoglobin (Hb) levels with the Hemocue Hb301 device in children aged 6 to 23 months in rural communities in the Lao People's Democratic Republic. Hb concentrations were compared with two automatic analyzers, showing that Hemocue yielded significantly higher results and a lower prevalence of anemia. The concordance is limited, and it is observed that the venous Hb per Hemocue is higher than the capillary Hb, which in turn exceeds the venous Hb of the analyzers. It highlights the importance of considering methodological discrepancies when assessing anemia in young children. Likewise, [25] in their research entitled "Validation of point-of-care hemoglobin estimation among pregnant women using digital hemoglobinometers (HemoCue 301 and HemoCue 201+) compared to the automatic analyzer", infers that the reliability and validity of the HemoCue 201+ and HemoCue 301 digital hemoglobinometers were evaluated compared to the Sysmex autoanalyzer as standard in pregnant women in antenatal clinics in Haryana, India. Capillary blood samples were analyzed with hemoglobinometers and compared with the results of the venous blood autoanalyzer. The mean difference in hemoglobin levels was -0.53 g/dL for HemoCue 201+ and -0.25 g/dL for HemoCue 301 compared to the autoanalyzer. Both devices showed moderate agreement and validity, with HemoCue 301 being slightly more valid than HemoCue 201+. In this way, [28] in his research titled "Validation of Masimo Pronto 7 and HemoCue 201 for hemoglobin determination in children aged 1 to 5 years," the study evaluated the accuracy of the HemoCue 201 and Masimo Pronto 7 devices in measuring hemoglobin in children aged one to five years, using capillary blood samples and comparing them to the gold standard of venous blood samples.

Both devices underestimated Hb concentrations compared to the gold standard, with regression and concordance correlation coefficients indicating similar predictability and accuracy. Although HemoCue and Masimo show comparable levels of accuracy and precision, they underestimate Hb concentrations relative to the gold standard.

The importance of enhanced training to ensure the proper use of these devices in studies is highlighted. That is why the main objective of this research is to know the current devices and techniques for detecting anemia in the world through the reliable Scopus database. To do this, the Scoping Review methodology and technological tools such as Python and R Language will be used to display the graphs. At the end of analyzing the results, it will be possible to observe a section of discussion, conclusion and recommendations aimed at those research communities, opening the way to new developments about devices for the detection of anemia.

2. Materials and Methods

To conduct a systematic review of the keywords associated with the detection of anemia using Scoping Review [6], [40], several steps will be followed. Initially, a comprehensive literature search will be conducted using relevant databases, primarily Scopus [41], [42], employing specific key terms related to the detection of anemia. Inclusion and exclusion criteria will be applied for the selection of relevant studies, focusing on devices, methods and technologies aimed at the detection of anaemia [43].

An exploratory review will then be conducted to map the diversity and breadth of research in this area. Subsequently, the collected data is analyzed and synthesized with the aim of identifying trends, gaps and key areas of interest [44]. This approach will provide a comprehensive view of existing research on anemia detection, thus establishing a solid foundation for future research and developments in this field [45]–[47].

2.1. Scoping Review

In the context of this research, we have chosen to use the Scoping Review methodology. This approach focuses on systematically exploring and mapping the available literature on diagnostic methods and electronic devices used for the detection of anemia [48]–[51]. The choice of this method is justified by its broad exploratory scope, which allows for the comprehensive identification of existing approaches, methods, and devices as documented in the literature [52], [53]. In addition, highlights that the detection of anemia is a constantly evolving field [54], [55], with continuous development of new devices for diagnosis in humans. In this context, Scoping Review presents itself as a robust tool for understanding current and emerging trends [30]. On the other hand, this methodology offers a wide source of information, including reports, studies, reviews, patents and other files, thus ensuring a more accurate and complete view in relation to the objective we are pursuing.

2.2. FlowChart

Figure 1 presents a flowchart that visualizes the process of our methodology [56], specially designed to explore the diagnostic methods and devices used in the global detection of anemia. We recognize that a flowchart constitutes an effective visual representation of any process, detailing the steps and decisions that will take place throughout the research [57]. In this context, the use of this diagram as a highly beneficial graphical tool [58] is valued, highlighting its ability to provide clarity and improve the understanding of the processes involved in the search for information on diagnostic methods and devices to detect anemia [1]. The visual representation thus becomes an effective means to facilitate the understanding of the scope and complexity of the research, clearly guiding towards the objectives set. In addition, the figure not only serves as a visual guide but also as a didactic resource that contributes to a more complete understanding of the methodology [59].

2.3. Searching for Information

In the field of research on diagnostic methods and devices for the detection of anemia, several database platforms stand out, with Scopus being one of the most prominent [41], [42]. This platform is distinguished by its exhaustive bibliographic categorization and its wide acceptance in the scientific and academic fields [42]. Scopus provides an intuitive and dynamic interface, making it easy to search a wide range of research documents, including articles, journals, conferences, patents, and books [41]. It is worth highlighting the special attention paid to each component of the Scopus interface, as detailed in Table 1, through a thorough analysis aimed at optimizing its use in the collection of relevant information for research on diagnostic methods and devices for the detection of anemia [61]. This detailed review aims to maximize the benefits of Scopus in the process of searching and selecting documents, thus ensuring the quality and relevance of the resources used in the research [62].
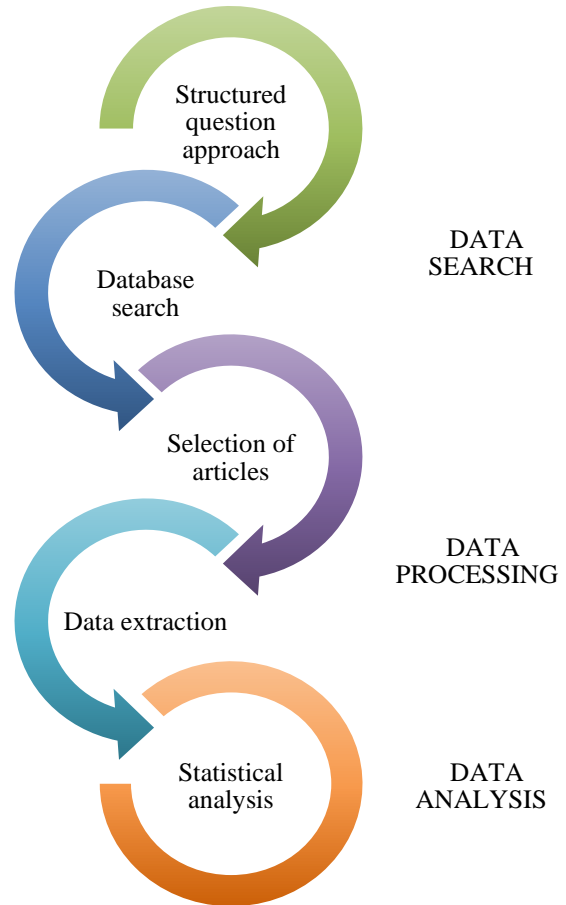

Fig. 1 Processes for searching for information

Table 1. Scopus components

Components	Description
Search bar	Write keywords, titles, authors or other terms related to the study.
Search filter	Refine results using filters by year, document type, author, source, and affiliation.
Search Result	Display in an ordered list.
Links to full-text	Provide direct links to the text.
Charts and metrics	Offer citation metrics
Export of results	Export search results in two formats: CSV or BibTeX.
Alerts and tracking	Set up notifications about new research.
Analysis tools	Provide analytical tools.

2.4. Information Selection and Filtering

Scopus offers specific classifications for its publications, including the Open Access category. However, this classification poses limitations in terms of the accessibility of information. In this context, the importance of the "All Open Access" category, which allows free and unrestricted access [41], is highlighted. In addition, other categories are mentioned, such as "Gold Open Access", where authors

assume the costs of publication [42], and "Green Open Access", which implies publication in institutional repositories or journals [42]. Finally, the "Bronze" category is mentioned, which refers to open-access articles in private-access journals. In relation to the search in Scopus, there is a persistent practice of using Boolean connectors to refine the search results according to the terms set [48]. The database enables advanced searches using connectors such as AND, OR, and AND NOT, which combine and refine search terms [63], [64]. For example, the AND connector allows you to combine two or more search terms to get more specific results, while the OR connector is used to expand search results [65]. During the search process, it focuses on obtaining specific types of documents, such as scientific articles and papers, that provide primary information [66]. These documents provide primary and experimental studies, as well as details on diagnostic methods and their originality [67]. In addition, it is highlighted that both the papers and the articles are up-to-date sources, providing greater specificity on the methods and devices for detecting anemia [68]. The need for manual filtering is emphasized to ensure quality and accuracy in the review [7], avoiding selection bias and aligning with the goal of investigating diagnostic methods and devices to detect anemia [69]. This approach ensures the integrity of the data collected and contributes to the reliability of the results obtained.

2.5. *Information Extraction* and Processing

After performing an exhaustive search for information, Scopus facilitates the export of data through files in CSV and BibTeX [70] format. The CSV format, according to [71], is a simple structure used to store data in lists, spreadsheets, and databases. Generally, information is separated by commas (,) or semicolons (;) [72]. On the other hand, the BibTeX format, according to [73], is a file designed to manage and organize bibliographic references that Scopus or other databases provide through personalized searches. This file contains detailed information about bibliographic references, such as articles, papers, or books [72]. The information obtained from these files can be represented visually using graphs [72]. VosViewer, a technological tool, allows you to create representations in networks and nodes, highlighting the key terms with the highest index [75]. In addition, Scopus has its own extensions that make it possible to create circular, bar and linear diagrams [42]. These visual tools make it easier to interpret and understand the data collected, providing a clearer and more accessible perspective [75].

2.6. Statistical Analysis

At this stage, it is crucial to delimit the relevant years for obtaining information related to the stated objective. In the context of this specific study focuses on the period between 2002 and 2023, considering the remarkable growth identified in the first selected years. A comprehensive analysis of various types of data, including the time of publication along this time range, is performed, allowing us to observe the evolution of diagnostic methods and devices for the detection of anemia.

At the same time, different aspects are examined, such as the typology of documents covering various sources of study [24]. An analysis of sponsors is carried out to identify those willing to invest in research. In addition, an analysis of the number of publications per country is carried out, which is essential to understand the geographical areas that concentrate the research [74]. Finally, cluster maps that incorporate the keywords [60] are used, establishing connections between the document co-occurrence terms. These maps provide a detailed visualization of the relationships between key concepts related to diagnostic methods and devices for the detection of anemia, thus offering a comprehensive perspective of research in this field [16].

3. Results

In the analysis of results, significant trends related to the detection of anemia using diagnostic methods and devices have been identified. The use of the reliable Scopus database has allowed for a systematic exploration and mapping of the scientific literature, with a particular focus on the crucial period from 2003 to 2024. The classification of documents according to the Scopus Open Access model has provided an in-depth understanding not only of the accessibility of information but also of the various constraints and their implications for anemia research. The application of Boolean connectors in advanced searches in Scopus has proven to be an instrumental tool to effectively fine-tune the results, adjusting to previously established key terms.

3.1. Searching for Information

A comprehensive data search was conducted through a literature review focusing on assistive devices for deaf children, collecting information in a manner consistent with the objective of the study. The importance of the selection criteria detailed in the methodology is underlined, which cover devices intended for deaf children and their components, excluding implants and invasive procedures. The algorithm developed from the Scopus database to effectively implement this selection criterion is presented below.

(TITLE-ABS-KEY (device) AND TITLE-ABS-KEY (anemia) AND TITLE-ABS-KEY (blood) OR TITLE-ABS-KEY (centrifuge) OR TITLE-ABS-KEY (hematocrit) OR TITLE-ABS-KEY (hemocue) OR TITLE-ABS-KEY (cyanohematocrit) OR TITLE-ABS-KEY (HEMATOMETER) OR TITLE-ABS-KEY (analyzer) OR TITLE-ABS-KEY (hemoglobin) OR TITLE-ABS-KEY (poc) OR TITLE-ABS-KEY (dried) OR TITLE-ABS-KEY (hemogram) OR TITLE-ABS-KEY (hematologist) OR TITLE-ABS-KEY (microcytosis) OR TITLE-ABS-KEY (thalassemia) OR TITLE-ABS-KEY (ferritin) OR TITLE-ABS-KEY (pheropenia) OR TITLE-ABS-KEY (anisocytosis) OR TITLE-ABS-KEY (transferrin) OR TITLE-ABS-KEY (hemina) OR TITLE-ABS-KEY (cyanomethemoglobein) OR TITLE-ABS-KEY (a) OR TITLE-ABS-KEY (a2) OR TITLE-ABS-KEY (f) OR TITLE-ABS-KEY (sulfate) OR TITLE-

ABS-KEY (ferrous) OR TITLE-ABS-KEY (glycosylated) OR TITLE-ABS-KEY (drabkin) OR TITLE-ABS-KEY (hemopexin) OR TITLE-ABS-KEY (crystalline) OR TITLE-ABS-KEY (spectrophotometer) OR TITLE-ABS-KEY (photometer) OR TITLE-ABS-KEY (hemocytometer) OR TITLE-ABS-KEY (centrifuge) OR TITLE-ABS-KEY (hematology) OR TITLE-ABS-KEY (absorption) OR TITLE-ABS-KEY (fluorescence) OR TITLE-ABS-KEY (absorption) OR TITLE-ABS-KEY (unique) OR TITLE-ABS-KEY (beam) OR TITLE-ABS-KEY (hemoglinometer) OR TITLE-ABS-KEY (laboratory) OR TITLE-ABS-KEY (low AND cost) OR TITLE-ABS-KEY (portable) OR TITLE-ABS-KEY (3d) OR TITLE-ABS-KEY (electrochemistry) OR TITLE-ABS-KEY (machine AND learning) OR TITLE-ABS-KEY (cnn) OR TITLE-ABS-KEY (ia) OR TITLE-ABS-KEY (clustering) OR TITLE-ABS-KEY (big AND data) OR TITLE-ABS-KEY (random AND forest) OR TITLE-ABS-KEY (FUZZY) OR TITLE-ABS-KEY (algorithm) OR TITLE-ABS-KEY (learning) OR TITLE-ABS-KEY (automata) OR TITLE-ABS-KEY (automatic) OR TITLE-ABS-KEY (artificial) OR TITLE-ABS-KEY (intelligence)) AND PUBYEAR > 2002 AND PUBYEAR < 2025 AND (EXCLUDE (DOCTYPE , "dp") OR EXCLUDE (DOCTYPE , "bk") OR EXCLUDE (DOCTYPE , "er") OR EXCLUDE (DOCTYPE , "cr") OR EXCLUDE (DOCTYPE , "SH") OR EXCLUDE (DOCTYPE , "ed") OR EXCLUDE (DOCTYPE , "ch") OR EXCLUDE (DOCTYPE , "no"))

Following the search algorithm above, the terms "anemia" and "device" and "Blood" were identified as primary and mandatory for our research. In contrast, the other terms connected with "OR" are not essential to the search and are considered complementary. The use of Scopus facilitated research and data collection using the algorithm mentioned above. The relevance of the Boolean search in this repository is highlighted, as it allowed an accurate search using connectors such as "AND" and "OR", providing control over the specification of the terms in our script. The first search with the required terms yielded a total of 4329 documents.

3.2. Information Selection and Filtering

After the analysis of the secondary filter in which publications from 2003 to 2024 were included, it was found that previous publications are much scarcer and do not have updated data to be used in this study. For this reason, only 4329 documents are considered, as these are the ones identified during the selected years. A Scopus API extension and Python scripts were used in the database to create graphs with author topics, number of published documents, publications by country, and percentages of publications by subject area. In this procedure, you should consider scanning clusters using VOSviewer and the CSV file that Scopus reintegrated at the end of the previous search filter.

3.3. Information Extraction and Processing

The following data were obtained from this methodological section.

Table 2. Filter by Document Type

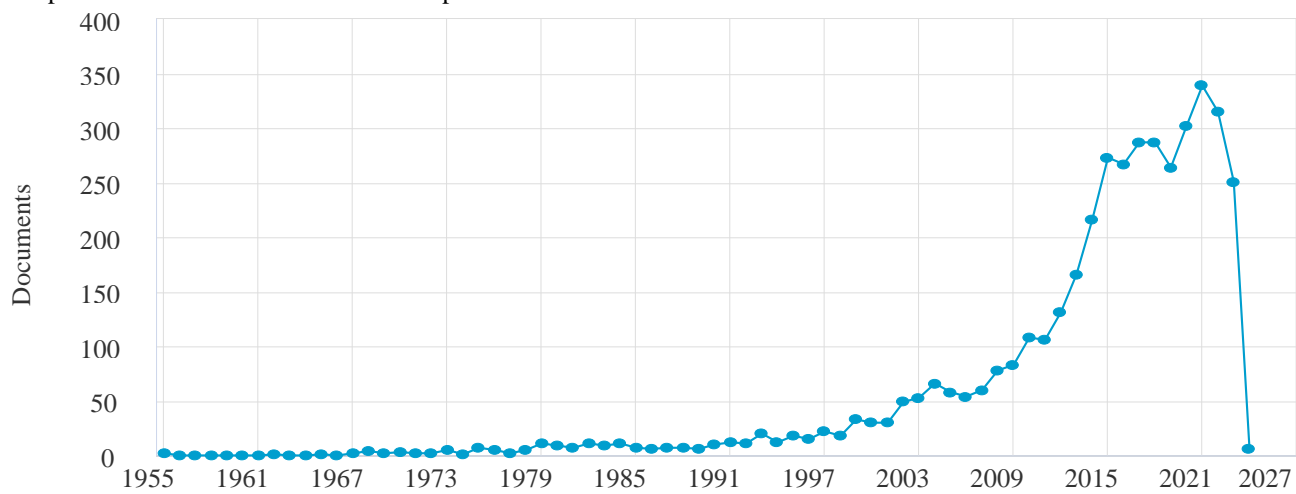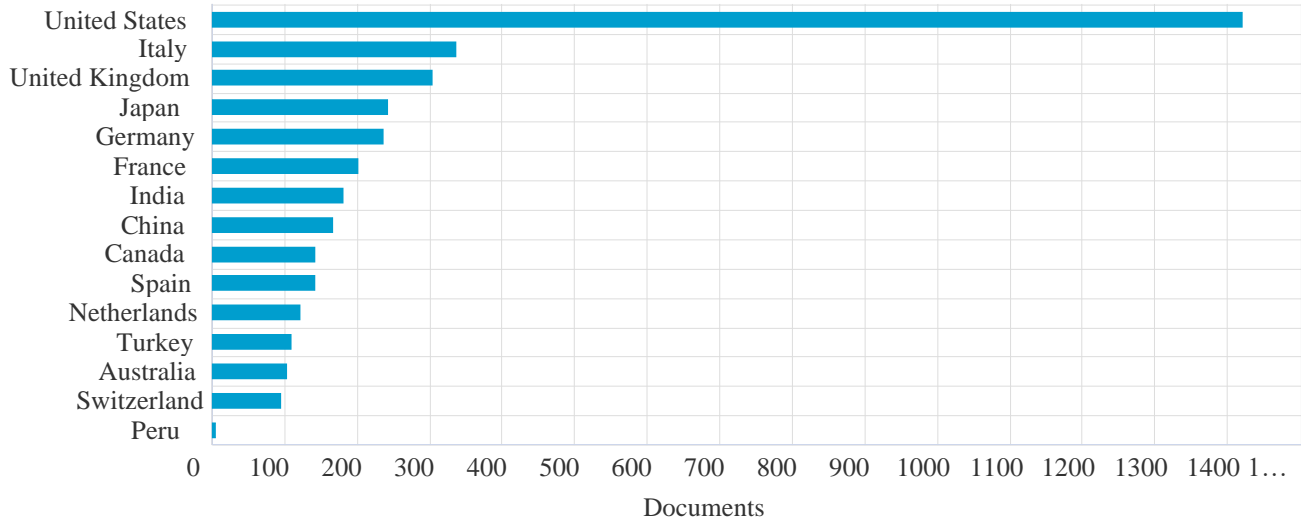| Filter by document type		
Article	-	3328
Review	-	605
Conference paper	-	144
Letter	-	108
Note	-	52
Book chapter	+	36
Editorial	+	30
Short survey	+	18
Conference review	+	3
Erratum	+	2
Book	+	2
Data paper	+	1

Fig. 2 Documents by year
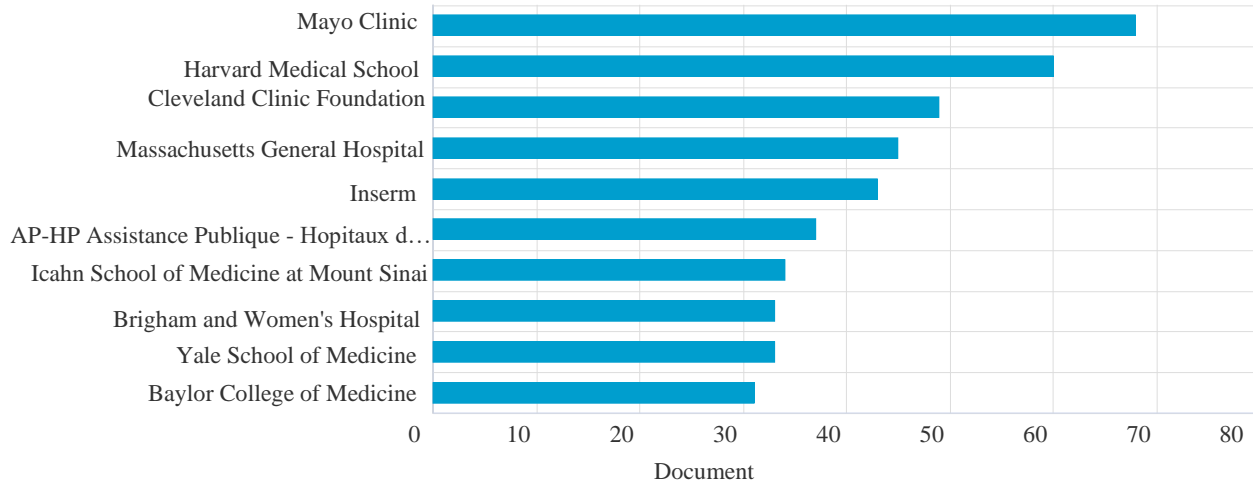
Fig. 3 Documents by country or territory

Fig. 4 Documents by affiliation

By performing the Scoping Review in Figure 2, it can be seen that our algorithm provided results since 1995. However, it is from 2003 onwards that there has been an exponential growth in research on anaemia, marking a significant milestone in the relevance and focus of this field of study. For this reason, the analysis of the results will be restricted with a cutoff point from 2003 to 2024, thus covering a period of 20 years in the systematic analysis. This approach is adopted to delimit the topics to be studied and to clarify more precisely the objective of the research. Figure 3 shows the geographical distribution of studies related to anaemia screening and reveals a marked concentration in selected countries. The United States leads the research with 1,421 studies, followed by Italy with 335 and the United Kingdom with 302. Together, these three countries account for almost half of the total research. Other countries highlighted in the research are Japan, Germany and France. However, it is important to note that research on anaemia screening is far from homogeneous and presents challenges in terms of global representation. Several countries, even some with significant populations, have limited or no contribution to this area of study. Addressing these disparities is crucial to a more complete understanding of anemia screening globally.

On the other hand, Figure 4 examines affiliations of institutions involved in anemia screening research and offers an interesting perspective on geographic distribution and collaboration in this field. The Mayo Clinic leads the field with an impressive total of 68 associated studies, followed closely by Harvard Medical School and the Cleveland Clinic Foundation, with 60 and 49 studies, respectively. These three institutions make up a significant part of the research landscape, as together, they contribute approximately 15% of the studies reviewed.
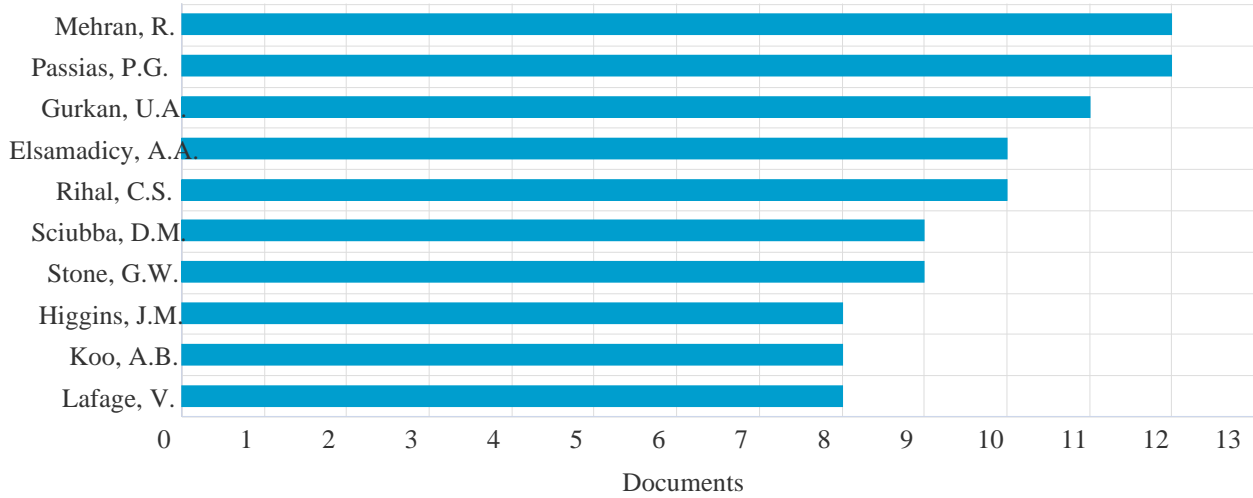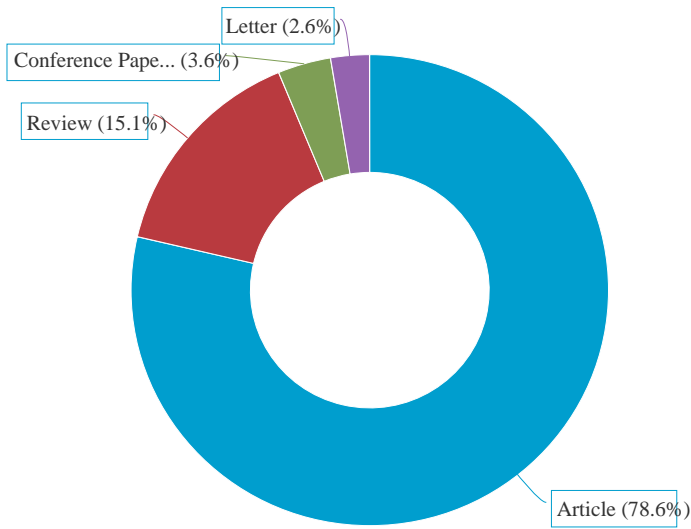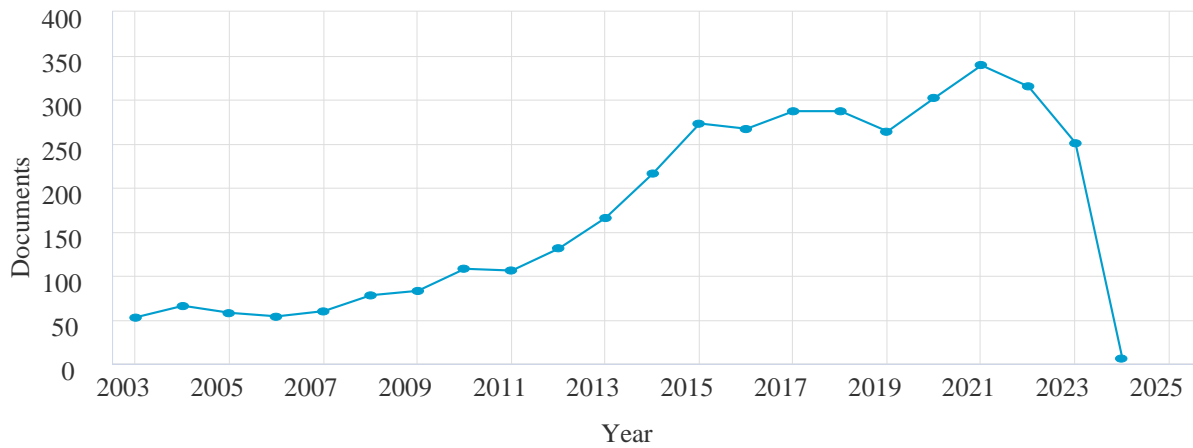
Fig. 5 Documents by author

Fig. 6 Documents by type

Fig. 7 The Number of publication related to the detection of anomia over the years

Since they represent a considerable part of this landscape, it would be beneficial to explore collaborations between institutions to address potential key areas of interest and improve the effectiveness of research efforts. This analysis also highlights the importance of more equitable representation of institutions from diverse geographic regions to ensure a global understanding of anemia screening and its impact on diverse populations.

Figure 5 presents the list of authors, which shows variability in the frequency of publications related to the detection of anemia. Mehran, R., and Passias, P.G. top the list with 12 papers each, followed by Gurkan, U.A. with 11, and Elsamadicy, A.A. and Rihal, C.S. with 10 each. This group of authors shows remarkable activity in research on the detection of anemia. In proportional terms, the top five authors (Mehran, Passias, Gurkan, Elsamadicy and Rihal) constitute approximately 19% of the total publications, underlining the concentration of research in the hands of a select group of experts. On the other hand, 50% of the authors on the list have 4 or more publications, indicating a relatively balanced distribution among researchers with a moderate level of activity.

According to Figure 6, the distribution of document types indicates that most records are classified as "Articles", reaching a total of 2965, which equates to approximately 78.69% of the dataset. The next most frequent category is "Review," with 570 records, accounting for about 15.1%. "Conference Papers" make up 3.6% of the total, with 136 papers, while "Letters" contributes 2.6%, with a total of 99 entries. This analysis suggests that most of the available literature is in the form of articles, highlighting the importance of original research in the field of anemia screening.

From a broader perspective, identifying common patterns, standout technologies, and specific gaps in these categories can provide a more detailed understanding of existing research. In addition, given the smaller number of Communications and Letters, it would be possible to examine specific areas where research is scarcer and, therefore, need greater attention in future research. This analysis more effectively contextualizes the current landscape of anaemia screening, thus establishing a solid basis for recommendations and future development in this field.

Figure 7 shows the trend in the number of publications related to the detection of anemia over the years, which shows some variability. From 2003 to 2010, there was a steady increase in the number of publications, peaking in 2011 with 106 publications. However, from that point on, there was a progressive decline until 2014, followed by an increase in 2015 and a subsequent fluctuation. It should be noted that the year 2023 shows a marked reduction compared to the previous year, going from 339 to 251 publications. This change could suggest an eventual slowdown in research into anemia screening. By examining this data, it is suggested to delve deeper into the reasons that explain the decrease in the number of publications in 2023. It would be pertinent to consider the inclusion of more detailed analyses, such as the geographical distribution of publications or the relationship between screening methods and the type of device used, in order to gain a more complete understanding of the research landscape around anaemia screening.

Fig. 8 Coocurence keywords

The analysis of Figure 8 presenting the keywords highlights the importance of certain key terms in studies on anemia screening. The orange dot representing "anemia" stands out and occupies a central position in the group, signaling its central relevance in the context of the systematic review. This finding underscores that anemia is the main focal point of the research. On the other hand, the prominent presence of the term "patients" in large red dots suggests that much of the research is focused on the clinical field, possibly related to the application of methods and devices in patients for the screening of anemia. Likewise, the presence of grey dots associated with "methods" is observed, which indicates the methodological importance of the studies reviewed. This aspect is crucial, as the quality of the methods used can directly affect the validity of the results obtained. Finally, the presence of green dots representing "study" highlights the attention paid to the research itself, indicating a strong scientific evidence base in the review. However, there is a dispersion of small points related to terms such as "disease", "age", "clinical" and "outcomes", which could suggest the presence of various variables and approaches in the studies reviewed.

4. Discussion and Conclusion

After obtaining significant results in relation to the main objective through the use of Scoping Review, a clear view of anemia detection devices was obtained. However, according to [40], which addresses the analysis of the 7 main methods of anemia detection, the application of cyanohematocrits stands out as the gold standard, recognized for its excellence in much of Latin America. It is important to note that we have observed a similarity in developing countries, where this method is also used as the gold standard for measuring hemoglobin concentration in campaigns against anemia.

Similarly, [Guy's (2017)] study reveals a high similarity to the HEMOCUE device. However, they point to an important limitation related to the number of tests available, which discourages their use in mass and public health settings.

These portable hemoglobinometric devices lack the necessary quality and durability. We agree with the view that, because of these limitations, traditional methods are still the most appropriate for addressing anaemia campaigns with a large number of patients. Finally, [Shamah's (2017)] analysis compares two point-of-care hemoglobinometers that seek to offer short- and long-term results with specificities and sensitivities close to 100%. Nonetheless, concerns remain about battery life and the potential for erroneous readings, especially when used without proper training, which can lead to ongoing concerns in patients with critical anemia.

By virtue of the above, it is concluded with the successful realization of the proposed objective, which sought to investigate the reality of devices for the detection of anemia worldwide. Several sets of related documents were identified, totaling 4329 publications focused on the topic of anemia, covering the period from 2003 to 2024. Within this group, the United States is positioned as the country with the highest contribution, with 1421 documents specifically dedicated to hemoglobin measurement devices.

In terms of affiliations that support research on the development and detection of anemia, the Mayo Clinic, located in the United States, stands out as the entity with the greatest support, participating in 68 studies on the subject. These findings offer a comprehensive and detailed overview of academic and research production in the field of anemia detection, highlighting the main geographical areas and research centers involved in this field.

Finally, the total number of scientific documents that converge with the primary objective of this research is highlighted, with these scientific articles being indexed in Scopus, with a total of 2967 documents. This body of academic work provides a solid and meaningful basis to address the key aspects related to the detection of anemia, thus consolidating the relevance and scope of the systematic review carried out.

As a prospect for future research, the creation of a Point of Care (POC) device that stands out for its prolonged durability and a constant power source is suggested. The implementation of a classic technique is advocated, backed by a gold standard of recognized excellence, which ensures high specificity and sensitivity. This approach aims to incentivize the involvement of the authorities in improving the control of anemia. This type of research will not only contribute to progress in the field of health. However, it will also open new lines of research in fields such as engineering and medical technology, promoting the development of innovative and sss solutions in the detection of anemia.

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